

Claims

What is claimed is:

1. An apparatus for coupling a tubular member to a preexisting structure, comprising:
 - a first support member including a first fluid passage;
 - a manifold coupled to the support member including:
 - a second fluid passage coupled to the first fluid passage including a throat passage adapted to receive a plug;
 - a third fluid passage coupled to the second fluid passage; and
 - a fourth fluid passage coupled to the second fluid passage;
 - a second support member coupled to the manifold including a fifth fluid passage coupled to the second fluid passage;
 - an expansion cone coupled to the second support member;
 - a tubular member coupled to the first support member including one or more sealing members positioned on an exterior surface;
 - a first interior chamber defined by the portion of the tubular member above the manifold, the first interior chamber coupled to the fourth fluid passage;
 - a second interior chamber defined by the portion of the tubular member between the manifold and the expansion cone, the second interior chamber coupled to the third fluid passage;
 - a third interior chamber defined by the portion of the tubular member below the expansion cone, the third interior chamber coupled to the fifth fluid passage; and
 - a shoe coupled to the tubular member including:
 - a throat passage coupled to the third interior chamber adapted to receive a wiper dart; and
 - a sixth fluid passage coupled to the throat passage.
2. A method of coupling a tubular member to a preexisting structure, comprising:

positioning a support member, an expansion cone, and a tubular member within a preexisting structure;
injecting a first quantity of a fluidic material into the preexisting structure below the expansion cone; and
injecting a second quantity of a fluidic material into the preexisting structure above the expansion cone.

3. An apparatus, comprising:
a preexisting structure; and
an expanded tubular member coupled to the preexisting structure;
wherein the expanded tubular member is coupled to the preexisting structure by a process comprising:
positioning a tubular support member defining an internal longitudinal passage, an expansion cone, and the tubular member within the preexisting structure;
injecting a first fluidic material through the internal passage of the tubular support member into the preexisting structure below the expansion cone; and
injecting a second fluidic material through the internal passage of the tubular support member into the preexisting structure above the expansion cone.

- Sub A'* 4. An apparatus for coupling two elements, comprising:
a support member including one or more support member slots;
a tubular member including one or more tubular member slots; and
a coupling for removably coupling the tubular member to the support member, including:
a coupling body movably coupled to the support member;
one or more coupling arms extending from the coupling body; and

coupling elements extending from corresponding coupling arms adapted to mate with corresponding support member and tubular member slots.

5. A method of coupling a first member to a second member, comprising:
forming a first set of coupling slots in the first member;
forming a second set of coupling slots in the second member;
aligning the first and second pairs of coupling slots; and
inserting coupling elements into each of the pairs of coupling slots.
6. An apparatus for controlling the flow of fluidic materials within a housing, comprising:
a first passage within the housing;
a throat passage within the housing fluidically coupled to the first passage adapted to receive a plug;
a second passage within the housing fluidically coupled to the throat passage;
a third passage within the housing fluidically coupled to the first passage;
one or more valve chambers within the housing fluidically coupled to the third passage including moveable valve elements;
a fourth passage within the housing fluidically coupled to the valve chambers and a region outside of the housing;
a fifth passage within the housing fluidically coupled to the second passage and controllably coupled to the valve chambers by corresponding valve elements; and
a sixth passage within the housing fluidically coupled to the second passage and the valve chambers.
7. A method of controlling the flow of fluidic materials within a housing including an inlet passage and an outlet passage, comprising:
injecting fluidic materials into the inlet passage;

a mandrel movably coupled to the support member and positioned within the tubular member;
an annular expansion cone coupled to the mandrel and movably coupled to the tubular member for radially expanding the tubular member; and
a lubrication assembly coupled to the mandrel for supplying a lubricant to the annular expansion cone, including:
a sealing member coupled to the annular member;
a body of lubricant positioned in an annular chamber defined by the space between the sealing member, the annular member, and the tubular member; and
a lubrication supply passage fluidically coupled to the body of lubricant and the annular expansion cone for supplying a lubricant to the annular expansion cone.

11. A method of operating an apparatus for radially expanding a tubular member including an expansion cone, comprising:
lubricating the interface between the expansion cone and the tubular member;
centrally positioning the expansion cone within the tubular member; and
applying a substantially constant axial force to the tubular member prior to a beginning of a radial expansion process.
12. An apparatus, comprising:
a support member;
a tubular member coupled to the support member;
an annular expansion cone movably coupled to the support member and the tubular member and positioned within the tubular member for radially expanding the tubular member; and
a preload assembly for applying an axial force to the annular expansion cone, including:

a compressed spring coupled to the support member for applying the axial force to the annular expansion cone; and
a spacer coupled to the support member for controlling the amount of spring compression.

13. An apparatus for coupling a tubular member to a preexisting structure, comprising:

- a support member;
- a manifold coupled to the support member for controlling the flow of fluidic materials within the apparatus;
- a radial expansion assembly movably coupled to the support member for radially expanding the tubular member; and
- a coupling assembly for removably coupling the tubular member to the support member.

14. An apparatus for coupling a tubular member to a preexisting structure, comprising:

- an annular support member including a first passage;
- a manifold coupled to the annular support member, including:
 - a throat passage fluidically coupled to the first passage adapted to receive a fluid plug;
 - a second passage fluidically coupled to the throat passage;
 - a third passage fluidically coupled to the first passage;
 - a fourth passage fluidically coupled to the third passage;
 - one or more valve chambers fluidically coupled to the fourth passage including corresponding movable valve elements;
 - one or more fifth passages fluidically coupled to the second passage and controllably coupled to corresponding valve chambers by corresponding movable valve elements;

one or more sixth passages fluidically coupled to a region outside of the manifold and to corresponding valve chambers;

one or more seventh passages fluidically coupled to corresponding valve chambers and the second passage; and

one or more force multiplier supply passages fluidically coupled to the fourth passage;

a force multiplier assembly coupled to the annular support member, including:

- a force multiplier tubular member coupled to the manifold;
- an annular force multiplier piston chamber defined by the space between the annular support member and the force multiplier tubular member and fluidically coupled to the force multiplier supply passages;
- an annular force multiplier piston positioned in the annular force multiplier piston chamber and movably coupled to the annular support member;
- a force multiplier sleeve coupled to the annular force multiplier piston;
- a force multiplier sleeve sealing member coupled to the annular support member and movably coupled to the force multiplier sleeve for sealing the interface between the force multiplier sleeve and the annular support member;
- an annular force multiplier exhaust chamber defined by the space between the annular force multiplier piston, the force multiplier sleeve, and the force multiplier sleeve sealing member; and
- a force multiplier exhaust passage fluidically coupled to the annular force multiplier exhaust chamber and the interior of the annular support member;

an expandable tubular member;

a radial expansion assembly movably coupled to the annular support member, including:

an annular mandrel positioned within the annular force multiplier piston chamber;

an annular expansion cone coupled to the annular mandrel and movably coupled to the expandable tubular member;

a lubrication assembly coupled to the annular mandrel for supplying lubrication to the interface between the annular expansion cone and the expandable tubular member;

a centralizer coupled to the annular mandrel for centering the annular expansion cone within the expandable tubular member; and

a preload assembly movably coupled to the annular support member for applying an axial force to the annular mandrel; and

a coupling assembly coupled to the annular support member and releasably coupled to the expandable tubular member, including:

a tubular coupling member coupled to the expandable tubular member including one or more tubular coupling member slots;

an annular support member coupling interface coupled to the annular support member including one or more annular support member coupling interface slots; and

a coupling device for releasably coupling the tubular coupling member to the annular support member coupling interface, including:

a coupling device body movably coupled to the annular support member;

one or more resilient coupling device arms extending from the coupling device body; and

one or more coupling device coupling elements extending from corresponding coupling device arms adapted to removably mate with corresponding tubular coupling member and annular support member coupling slots.

15. A method of coupling a tubular member to a pre-existing structure, comprising:

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positioning an expansion cone and the tubular member within the preexisting structure using a support member;
displacing the expansion cone relative to the tubular member in the axial direction; and
decoupling the support member from the tubular member.

16. An apparatus, comprising:
a preexisting structure; and
a radially expanded tubular member coupled to the preexisting structure by a process comprising:
positioning an expansion cone and the tubular member within the preexisting structure using a support member;
displacing the expansion cone relative to the tubular member in the axial direction; and
decoupling the support member from the tubular member.
17. The apparatus of claim 4, wherein the coupling arms extend from the tubular coupling body in a longitudinal direction.
18. The apparatus of claim 4, wherein the coupling elements extend from corresponding coupling arms in a radial direction.
19. The apparatus of claim 4, further comprising:
a tubular support member defining an internal passage having a throat passage, a plurality of radial passages coupled to the internal passage, and an external shoulder that is coupled to the inner tubular member.
20. The apparatus of claim 19, wherein the tubular coupling body is movably coupled to the tubular support member.

21. The apparatus of claim 19, further comprising:
a locking member coupled to the coupling assembly that comprises:
a tubular locking body movably coupled to the tubular support member;
and
a plurality of locking dogs movably coupled to the tubular locking body for
engaging the shoulder of the tubular support member.
22. The apparatus of claim 19, further comprising:
a tubular retaining sleeve releasably coupled to the tubular support member for
retaining the coupling elements within the corresponding pairs of outer
tubular member member and inner tubular member slots.
23. The apparatus of claim 22, further comprising:
an annular pressure chamber defined between the tubular support member and
the tubular retaining sleeve that is fluidicly coupled to the radial passages
of the tubular support member.
24. An apparatus, comprising:
an outer tubular member;
an inner tubular member positioned within the outer tubular member; and
a coupling assembly for releasably coupling the outer tubular member to the
inner tubular member at a plurality of discrete circumferentially spaced
apart locations.
25. The apparatus of claim 24, further comprising:
a decoupling assembly for controllably decoupling the outer tubular member from
the inner tubular member if the operating pressure within the inner tubular
member exceeds a predetermined value.

26. The apparatus of claim 24, further comprising:
a decoupling assembly for controllably decoupling the outer tubular member from the inner tubular member if the inner tubular member is displaced in a longitudinal direction relative to the outer tubular member and then displaced in an opposite longitudinal direction relative to the outer tubular member.
27. An apparatus, comprising:
an outer tubular member;
an inner tubular member positioned within the outer tubular member; and
means for releasably coupling the outer tubular member to the inner tubular member.
28. The apparatus of claim 27, wherein the means for releasably coupling the outer tubular member to the inner tubular member comprises:
means for releasably coupling the outer tubular member to the inner tubular member at a plurality of circumferentially spaced apart positions.
29. The apparatus of claim 27, further comprising:
means for decoupling the inner tubular member from the outer tubular member.
30. The apparatus of claim 29, wherein the means for decoupling the inner tubular member from the outer tubular member comprises:
means for decoupling the inner tubular member from the outer tubular member if the operating pressure within the inner tubular member exceeds a predetermined value.
31. The apparatus of claim 29, wherein the means for decoupling the inner tubular member from the outer tubular member comprises:

an annular pressure chamber defined between the tubular support member and the tubular retaining sleeve that is fluidically coupled to the radial passages of the tubular support member.

33. An apparatus, comprising:
- an outer tubular member;
 - an inner tubular member positioned within the outer tubular member;
 - a coupling assembly for releasably coupling the outer tubular member to the inner tubular member at a plurality of discrete circumferentially spaced apart locations;
 - a first decoupling assembly for controllably decoupling the outer tubular member from the inner tubular member if the operating pressure within the inner tubular member exceeds a predetermined value; and
 - a second decoupling assembly for controllably decoupling the outer tubular member from the inner tubular member if the inner tubular member is displaced in a longitudinal direction relative to the outer tubular member and then displaced in an opposite longitudinal direction relative to the outer tubular member.
34. An apparatus, comprising:
- an outer tubular member;
 - an inner tubular member positioned within the outer tubular member;
 - means for releasably coupling the outer tubular member to the inner tubular member at a plurality of circumferentially spaced apart positions;
 - means for decoupling the inner tubular member from the outer tubular member if the operating pressure within the inner tubular member exceeds a predetermined value; and
 - means for decoupling the inner tubular member from the outer tubular member if the inner tubular member is displaced relative to the outer tubular member

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in a longitudinal direction and then displaced relative to the outer tubular member in an opposite longitudinal direction.